# U.S. Army Center for Health Promotion and Preventive Medicine



CHEMICAL STOCKPILE EMERGENCY PREPAREDNESS PROGRAM RECOVERY SAMPLING AND ANALYSIS PLAN PROTOCOL

CHEMICAL WARFARE AGENTS ACCIDENTS/INCIDENTS

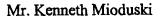












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# CHEMICAL STOCKPILE EMERGENCY PREPAREDNESS PROGRAM (CSEPP) RECOVERY SAMPLING AND ANALYSIS PLAN (RSAP) PROTOCOL for CHEMICAL WARFARE AGENT (CWA) ACCIDENTS/INCIDENTS

#### SECTION I

- 1. PURPOSE.: The purpose of this document is to provide guidance to the Chemical Stockpile Emergency Preparedness Program (CSEPP) communities on how to establish site-specific Recovery Sampling and Analysis Plans (RSAPs). As this guidance uses example and some theoretical information, SPECIFIC DETAILS SHOULD NOT BE CONSTRUED AS ARMY-POSITION/POLICY. A site-specific RSAP must be developed, reviewed, and approved by the appropriate Army, Federal, State and local representatives.
- 2. APPLICATION. Specifically, this guidance is presented in the form of a protocol (Section II) that provides the guidance and information necessary to develop and execute an RSAP as required in Department of the Army (DA) Pamphlet (PAM) 50-6. The RSAP itself will ensure that reentry/restoration decisions associated with a Chemical Agent accident/incident (CAI) are determined through appropriate scientifically-based evaluations of public health and the environment. The CSEPP communities can use this protocol as a tool for developing site specific RSAPs. The protocol was written in the outline of an RSAP, however, some key information will need to be filled in by the local CSEPP working groups in order for it to be complete. For purposes of demonstrating how the protocol can be implemented, Section III provides an example of a site-specific RSAP.
- 3. BACKGROUND. In 1988, the CSEPP was established in response to Public Law 99-145 which directed the Department of Defense (DoD) to destroy the stockpile of chemical warfare agents (CWA). The DoD currently stockpiles CWA at eight U.S. Army Installations located throughout the continental United States. With the anticipated increase in CWA activities at the stockpile sites, the CSEPP was started to enhance and prepare local community emergency response units for any CWA accident/incident (CAI) which may occur at these installations. In 1997, CSEPP established the Off Post Monitoring Integrated Product Team (OPMIPT). The OPMIPTs role is to prepare guidance for establishing plans necessary to fulfill CSEPP's mission. One such plan is the RSAP. This plan is to detail the methodologies, analytical/laboratory requirements, and data evaluation approach necessary to allow reentry into CAI areas. In the past, a CAI exercise consisted primarily of the initial response to

the release and concluded when the release was contained. Little consideration was given to the after effects of such a release to the surrounding communities and how they would be impacted by CWA contamination. Due to increased awareness resulting from the inception of CSEPP, more emphasis and attention has been placed community preparedness and readiness response to include recovery/reentry activities after an CAI event (reference 1). The CSEPP community at each of stockpile installations has been tasked to prepare an RSAP specific to their needs/locale. The status of the RSAPs varies at each site. To facilitate the RSAP preparation process, the IPT has tasked the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) to prepare a protocol from which RSAPs can be developed. The principle behind the development of this protocol was to provide a basis from which RSAPs can be developed based on Army Regulation (AR) /DA PAM 50-6 (references 2 and 3). In DA PAM 50-6, the U.S. Army outlines the requirements for responding to an CAI from initial response to site remediation and environmental monitoring. While providing this guidance and specifying monitoring requirements, there are no direct guidelines detailing how recovery/restoration efforts are to be executed. Rather, guidance comes in the form of following U.S. Environmental Protection Agency (EPA) approved procedures. Currently, the EPA does not specifically regulate CWA nor have they approved any procedures, methods, or cleanup standards specific for CWA, although several states now require CWA wastes to managed as hazardous wastes. The DA has various procedures in place for decontamination and disposal (AR & DA PAM 385-61, references 4 and 5). Currently, the DA Steering Committee for Standards in Emergency Response, Remediation, Restoration, and Demilitarization of Chemical Warfare Material (SCS) is reevaluating existing procedures and refining the guidance to include specific concentration levels for screening various environmental media.

4. OTHER GUIDANCE/REFERENCE SOURCES. In addition to this protocol, other existing CSEPP guidance on reentry/recovery issues should be referred to when developing an RSAP. Specific key documents are listed in Appendix A, References.

#### SECTION II

## 1. THE PROTOCOL FOR DEVELOPING A RSAP.

- a. Stockpile installations typically have 'likely' CAI scenarios developed as part of their planning requirements under the Army's CAIRA procedures. Information from these 'incident scenarios' as well as site-specific background information should be used in conjunction with this protocol to complete site specific RSAPs. The sampling strategies that follow have been written such that they can be applied to any CAI. The foundation of these strategies are based on statistics and recommended EPA sampling guidelines and techniques. The protocol as written, is highly adaptable AND SHOULD NOT BE CONSTRUED AS FINAL POLICY OR POSITION. It is provided as guidance only. The number of samples required for each specific sample media (i.e., wipes, soils, air, water, miscellaneous) will be specific to each CAI. The numbers of samples required to be collected represent the level of confidence in any said declaration of an CAI area. The more samples collected, the higher degree of confidence; but sampling requirements will have to be balanced with analytical laboratory capacity and time constraints. The equations and references used to develop the numbers herein can be modified to meet each specific scenario need. When implemented, well executed RSAPs will provide the technical basis to 'clear' areas for reentry and identify potential areas of concern which will require more detailed evaluations. Due to the significant time and effort involved in collecting and documenting the background information required for an RSAP and coordinating decisions and approvals amongst the Army, Federal, State, and local representatives, IT IS CRITICAL TO DEVELOP A DETAILED RSAP BEFORE A CAI OCCURS.
- b. The following sections provide an outline of the information that should be contained in an actual RSAP. Each section describes certain issues, information, or procedures that should be considered and documented in a site/event-specific plan. Section III includes an example of the procedures and type of information to be documented. This example was based on information from the Pine Bluff Arsenal (PBA) (reference 6). Users of this protocol should complete each section with site/event-specific information.
- 2. RSAP TABLE OF CONTENTS. An example table of contents of an RSAP is displayed in Figure 1 below. A detailed discussion of the information needed in each section follows:

Figure 1. Example Table of Contents

- ♦ PURPOSE
- ♦ KEY POINTS OF CONTACT AND RESPONSIBILITIES
- ♦ ASSOCIATED DOCUMENTATION AND REFERENCES
- ♦ SITE BACKGROUND INFORMATION

#### General Site Description and Location

#### Local Demographics and Land Usage

- -Populations of Concern
- -Key Land Areas/Uses of Concern
- Other Political/Public Concerns

# Site CWA and Stockpile

## Environmental Setting

- -Climate
- -Topography
- -Surface Water
- Groundwater
- -Soil

#### ♦ INCIDENT INFORMATION REQUIREMENTS

#### General Incident Description

- Agent Ttype, Amount
- Release Type
- Hazard Analysis Conclusions (Release Modeling)
- Emergency/Mitigation Pprocedures
- ♦ INCIDENT-SPECIFIC SITE EVALUATION

**Environmental Pathways** 

Exposure Sources

**♦** SAMPLING STRATEGY

Goal

**Identifying Sample Locations** 

Site Selection Process

Sample Collection

**Extreme Climatic Conditions** 

Collection Priorities

Field Quality Assurance/Quality Control (QA/QC) Procedures

Data Quality Objectives

♦ ANALYTICAL/LABORATORY REQUIREMENTS

Analytical Methodolgies

Laboratory Quality Assurance/Quality Control

♦ FIELD ACTIVITIES - SPECIFIC PROCEDURES AND RESPONSIBILITIES

Schedule

Responsibilities

Sample Handling and Management

Recordkeeping

Chain-of-Custody

Resources

Decontamination Procedure

Waste Management

- ♦ DATA EVALUATION
- ♦ OTHER PROJECT MANAGEMENT REQUIREMENTS

Organizational Roles and Coordination

Supplies
Site Safety and Health Plan
Data Interpretation and ReleaseDecision Documentation
Risk Communication

- 3. PURPOSE. The purpose of the RSAP is to detail the methodologies, analytical/laboratory requirements, and data evaluation approach necessary to make prudent, scientifically defensible reentry/restoration decisions regarding Chemical Agent accident/incident (CAI) areas. Specifically, the RSAP designates the specific procedures to be used to collect the necessary information to perform scientifically-based evaluations of health impacts from potential residual chemical agent contamination. The plan also identifies the information and procedures necessary to document evidence of any past presence of chemical agent through residual breakdown products.
- 4. KEY POINTS OF CONTACT AND RESPONSIBILITIES. The RSAP must identify specific names and organizations associated with its development, approval, and implementation. Phone numbers should also be included. This information may be contained in the body of the RSAP or as an Appendix.
- 5. ASSOCIATED DOCUMENTATION AND REFERENCES. Several existing documents (such as those referenced in this protocol) are available to address specific CSEPP issues to include policies and technical references. In addition to these, specific documents contain site-specific information, AND event-specific information can be cited. To the extent possible, all such information sources should be cited/referenced to ensure consistency and avoid the necessity to duplicate already documented information. This information can be consolidated in an Appendix.

#### 6. SITE BACKGROUND INFORMATION.

- a. General Site Description and Location. Site location directly impacts the extent of sampling that will be required. The number of samples that will be collected is dependent both on the size of the CAI and on the surrounding locale (i.e. land usage, nearby towns/cities, industry, etc.). These will not only impact the number of samples to be collected but may impact the priority and types to be collected. Sites located in more isolated area should focus primarily on soil and water sampling activities. Whereas, sites located in more populated and developed areas will need to focus on wipe, air, and miscellaneous sampling activities in addition to soil and water sampling. The RSAP should include a site map and describe the general characteristics of the surrounding area. Specifically, actual agent storage location in relationship to the installation boundaries as well as specific nearby towns/cities and other, should be demonstrated.
- b. <u>Local Demographics and Land Usage</u>. A discussion of the general population and activities surrounding the site will provide incites as to where sampling locations may need to focus or at least accommodate. Specifically, the following information should at least be summarized and documented:

- (1) Populations of Concern. The RSAP should include a discussion of different communities and/or activities involving distinct sub-populations that may be of particular concern and/or susceptibility to include elderly groups (convalescent centers), children (day-care centers, schools, playgrounds).
- (2) Key Land Areas/Uses of Concern. In addition to populations and specific activities that may impact sampling decisions, other land uses such as farming and specific agricultural use activities, and recreational areas should be identified. As discussed in other CSEPP guidance (reference 25), it is particularly essential that CSEPP sites be prepared to 'prove' safety of key agricultural products and land uses that affect local economy. The ramifications of potential 'embargos' on such resources could be potentially quite significant, even if chemical agent contamination had not occurred to avoid 'perception' based reactions, sampling design should ensure that some 'hard data' will support claims of no-risk or no-contamination.
- (3) Other Political/Public Concerns. It may be wise to consider other political/public concerns such as those of vocal activist groups different perspectives should be considered *before* sampling actually occurs otherwise the 'acceptability' of the sample results and conclusions based on the results may be questioned.
- c. <u>CWA</u> and <u>Stockpile Characteristics</u>. Stockpile sites are required to assess the potential hazards and dangers associated with the specific CWA/Chemical Warfare Munitions (CWM) operations located on the installation. This essentially entails reviewing what CWA are maintained on the installation and how they are handled/stored. The RSAPs will need to be prepared such that they address all stockpile CWA that are determined to be present. Specific information regarding the CWA(s) (e.g. toxicity, chemical characteristics, environmental fate) should be identified in the RSAP. This can be accomplished by simply referencing other key documents [e.g. Material Safety Data Sheets (MSDSs); CHPPM Tech Guide 218 Detailed and General Fact about Chemical Agents; Army Field Manual (FM) 3-9, etc.].

## d. Environmental Setting.

- (1) Climate. The affects of the climatic conditions on the sampling plan will only be known when or after the CAI has occurred. 'Likely' scenarios have been developed taking into account the typical conditions at any one time. Air dispersion and soil deposition models are used to identify potentially impacted areas. For preplanning purposes, these allow for the number and types of potential samples that will be collected to be estimated. Unfortunately, nature may not follow a 'likely' scenario. As such, if an CAI does occur, extreme climatic conditions (e.g. thunderstorm, tornado, hurricane, etc.) would dramatically impact the implementation of the RSAP.
- (2) Topography. Special terrain features should be identified. Local terrain may impact the CAI deposition model. High points such as hills, mountains, and forests may steer CWA laden winds around areas while low points such as gullies, valleys, and basins might pool and collect CWA clouds or serve

as channels funneling CWA clouds down and away from the release point. The sampling grid will cover the general deposition area, but these terrain features located within this area deserve attention since the area impacted by the plume may not be identified by the model. Therefore, it will be necessary to ensure these areas are adequately evaluated for how they may potentially impact or require adjustments to the RSAP. By identifying these locations prior to an CAI, implementation of the sampling plan will be facilitated.

- (3) Surface Water. In the event of a CAI, it will be necessary to evaluate deposition of CWA at surface water locations. All surface water locations surrounding the stockpile site should be documented prior to an CAI. These should include rivers, large streams, and lakes with special emphasis being placed on ones being used for recreational and commercial activities. Again. by identifying these locations prior to a CAI, implementation of the sampling plan will be facilitated.
- (4) Groundwater. While in most cases it is unlikely that groundwater would become contaminated, certain types of incident release and hydrogeological conditions should be evaluated to ensure that this is not a significant environmental media of concern (reference 7). These will in all likelihood will not pose an immediate threat due to the inherent movement rate of ground water (upperbounds of 100-200 feet/day). Potential ground water contamination should be evaluated on a site specific basis.
- (5) Soils. The types of soil found in the outlying areas surrounding the stockpile installation will not bear any immediate impact on the sampling plan. The CWA that are maintained will impact what information is needed, specifically background sampling. In general, background sampling should not be needed. Chemical warfare agents and their breakdown components are unique enough such that there should not be any interferences by which false positives or negatives will occur. In the case of Deseret where Lewisite is stockpiled, average soil concentrations of Arsenic should be determined since the current means of measuring Lewisite concentrations in any media is via total Arsenic. Background concentrations of arsenic may be documented in scientific literature, thereby, eliminating the need to actually collect background samples (reference 8).
- 7. INCIDENT INFORMATION REQUIREMENTS. When the amount and types of agent that have been released have been determined, the path and size of the plume should be modeled using an atmospheric dispersion (e.g. D2PC, reference 9) and soil deposition (e.g. GAPCAP) models. These programs do not take into account topography and such but will give a quick, conservative estimation of the CWA plume and resulting ground deposition. Models will predict the area impacted by the CAI which will dictate the number, types, and priority of sample collection. Field reports which indicate the presence or passage of the CWA plume should be noted for possible miscellaneous sampling activities. Reports or rumors of CWA presence outside the model area should be reviewed on a case-by-case basis taking into consideration the location from which the report originated with respect to the initial release site, geographical features laying between the two areas, and the demography of the area in question. The RSAP should summarize the key information described and reference other documentation established in response to the incident. Specifically, the information should include a general description of the incident, the agent type, amount, type of release, fires/other transport mechanisms

involved, description/reference to the Hazard Analyses (Release Modeling), and summary of initial emergency operations/mitigation actions taken (to include what areas were evacuated).

- 8. INCIDENT-SPECIFIC SITE EVALUATION. Based on the incident information described in Section 7 and the site background information described in Section 6, one must evaluate the situation for determining potential health impacts both from direct or indirect exposure to CWA.
- a. <u>Exposure Pathways</u>. Exposure pathways are routes in which persons of animals can be potentially exposed to a given chemical. These 'pathways' include the three modes by which chemical contaminant may enter the human body: ingestion, inhalation, and dermal absorption. A 'completed' pathway is one where there is deemed a contaminated source media (soil, water, air, and surfaces) and conditions allow contact with the contaminated source through the pathway in question.
- b. <u>Exposure Sources</u>. Exposure sources are routes in which persons or animals can be potentially exposed to a given chemical concern. In the case of a CAI, a CWA plume may be released to the surrounding countryside. As the plume passes and dissipates, CWA may volatilize and never impact anyone. It is possible, however, that CWA will precipitate from the plume contaminating some area of land. This results in some amount of CWA being deposited on buildings, automobiles, trees, fields, etc. By evaluating these media, we determine the sources that have the greatest potential for impacting the general population. And in doing so, determine what we need to sample. For CAI, the following sources of exposure have been identified: soil, structural surfaces, surface water, and air. A fifth category called miscellaneous has also been established. This category will be used to address stockpile site specific locations.
- (1) Soil. In most cases, the majority of surface area to receive CWA deposition, if any, will occur on surface soil. Persons and animals come in contact with surface soil on a daily basis. Since the area of deposition may occur over a large area, various types of activities, hunting, farming, recreation, etc. may be impacted. Surface soil samples may be collected and analyzed in order to evaluate this pathway. These samples will be collected from a cross section of the impacted area. Sample points will be determined with the use of a sample grid.
- (2) Structural Surface. The source of exposure will be from CWA deposition on buildings and structures. These will consist of residential dwellings, office buildings, commercial activities, and automobiles. This source of potential exposure will be the most critical since some of the surfaces exposed (i.e. glass) to CWA deposition will absorb little, if any, of the material. Chemical warfare residues will potentially remain on these surfaces until absorbed, washed or removed via decontamination solutions, naturally degraded, or until it is come in contact with by a person or animal. Wipe samples will be collected and analyzed in order to evaluate this pathway. Although, wipe samples will be collected only from nonporous media, data generated from these analyses may be used to evaluate exposure via porous/semiporous media in the immediate vicinity. Wipe sample locations will be determined statistically but will be biased to sensitive populations (hospitals, day-care facilities, schools, etc.).

- (3) Surface Water. Existing weather conditions will play a major part in where and how many water samples to collect. There are two types of water, lotic and lentic. Lotic describes fast-moving, nonstationary water (e.g. rivers and streams). Lentic describes stationary, nonmoving (e.g. ponds, marshes). For lotic waters, obtaining a representative sample will be difficult (reference 10). Any CWA deposited on the water surface will be swept downgradient. The sheer volume of water will serve to dilute the CWA to levels well below any detectable concentrations. Exposure via lotic waters should be considered complete, but a minor source given the dilution that will occur. For lentic waters, CWA deposited in the surface will not be mixed and carried aware by the water. Rather, it will collect on the surface and diffuse into the water. Diffusion is a slow process. Chemical warfare agents may be diluted, hydrolyze, and/or form a film on the surface. Surface water samples will be collected and analyzed from identified locations in order to evaluate this pathway. Surface water locations to be sampled will be determined statistically.
- (4) Air. In place sheltering is the primary means of protection when a CWA release initial occurs. Persons are to remain in place until further instructions are issued. This assumes at some given point that these persons will be evacuated from their location to an area outside the impacted area. Remaining in place until the entire CAI has concluded is not an option. One study (reference 11) has indicated that the initial protection provided by in place sheltering is superior to no protection. However, due to convection currents and such, indoor CWA concentrations increase and persist longer than outdoor concentrations. Air sampling will determine whether the indoor concentrations of CWA are safe prior to building reoccupancy. This sampling will determine whether or not indoor areas need to be decontaminated in any way. Buildings and structures to be sampled will be determined statistically but will be biased to sensitive populations. Note: air monitoring will probably occur prior to entering structures. Air monitoring cannot be used as a substitute for air sampling. Monitoring will occur primarily to ensure sampling personnel safety while conducting sampling activities.
- (5) Miscellaneous. The exposure pathways listed above for the most part identify the major exposure scenarios. This section should contain those pathways which are unique to the stockpile site in question. These might be certain food crops, farms, large schools, etc. Special attention should be given these to ensure that pathways specific to these types of facilities/institutions are either adequately addressed via sampling or through management controls (e.g. disposal of potentially contaminated food items) for one of the above pathways or via the miscellaneous sampling route (reference 1). Though these types of samples may be desirable for certain assessment purposes, be aware that analytical capabilities may be particularly limited. In addition there are no standard criteria/methododolgies for assessing the 'significance' of risk to or from of these types of 'special media,' and if attainable, these results will generally require a very detailed risk assessment. Such samples should only be taken if deemed absolutely necessary (to answer key public health concerns). If the conditions at the site/incident (see section 5) suggest that ground water could potentially become contaminated, then contingency sampling requirements would have to addressed.
- 9. SAMPLING STRATEGY. Questions such as "What should be sampled?", "Where to sample?",

and "How to sample?" are addressed in the sampling strategy which should contain the following components:

a. Goals. The goal of sample collection will be to determine the presence/deposition of CWA which may result in an immediate (acute) and/or long-term (chronic) health effect to the surrounding population resulting from the CAI. Sampling will also be designed to identify areas where contamination may have existed initially but has broken down into more environmentally persistent compounds. This will be accomplished by collecting a number of environmental samples from predetermined and vital areas both within and outside of the CAI area. Health officials will then use the analytical data to determine whether impacted areas are safe for reentry and to what extent remediation is required using health based standards for CWA/byproducts.

## b. <u>Identifying Sample Locations</u>.

- (1) Selection schemes. Sample locations will be determined using a combination of the three following sampling schemes:
- (a) A systematic grid approach (search sampling) (reference 12) will be used to determine specific sample locations across the impacted area. Soil samples will be collected at each grid coordinate " 100 feet.
- (b) A statistical approach will be used to determine the number of wipe, water, and air samples that are to be collected from within each active grid (reference 13).
- (c) A biased sampling approach will be used to collect miscellaneous samples throughout the impacted area to address key populations and/or land areas of concern (as described in Section 8b) that could potentially be exposed (as determined in Section 7) as well as to address specific findings (e.g. dead animals and wilted plants outside of the immediate release area) and unusual areas (e.g. gullies, forests, ponds) that the model cannot account for within the impacted area.
- c. <u>Site Selection Process</u>. The area located within the immediate response zone (IRZ) will overlaid with a grid (Figure 1). This can be accomplished using the global imaging system (GIS). Sample maps can prepared prior to the CAI to allow easy application of an appropriate grid.
- (1) Implementation of Grid Areas. Based on the deposition models, the grid areas that have been impacted by CWA will require sampling. The deposition area should be completely surrounded by grid vertices which fall outside this area. Grid vertices located within 0.5 miles of the deposition should be sampled to include the areas within the grid acting as a buffer zone. Grids located within the IPZ which require sampling of any sort are designated as 'active.' From within the active grid areas, air, wipe, water, soil and miscellaneous samples will be collected. It may be necessary to extend sampling activities into other grid areas thereby making them active. If samples collected on the outer fringe of the grid area are positive for CWA, the grid will be expanded outward until active grids fully

encompasses this 'hot spot.' Rumors or field reports of CWA presence outside the grid area will require review. Based upon review, these may be determined to be coincidental to the CAI. If, however, they are deemed valid, the grid area which has been identified will hence become active until sample results prove otherwise.

- (2) Grid Zones. Plumes of CWA will initially be a 'compact mass' when released. As the plume moves further from the release point, the CWA will become more evenly distributed covering a much larger area. The zones closer to the release point should be expected to have higher levels of CWA deposition. Chemical warfare agents deposited in the zones furthest from the release point will, for the most part, be more evenly distributed. Hence, sampling efforts closer to the release point will be more intensified. The CWA deposition will occur over a much smaller area and will not be as evenly distributed or dispersed. Identification of the 'hot spots' will be more crucial due the expected higher concentrations of CWA. Zones further away will be sampled less extensively. The CWA deposition will cover a larger area and be more evenly dispersed. The identification of an 'impacted area' is more critical. The IRZ was divided into four zones - A, B, C, and D. The Zone A radius will be 0-0.5 miles (0-805 meters), zone B 0.5-1.5 miles (805-2414 meters), zone C 1.5-3.5 miles (2414-5632 meters), and zone D 3.5-9.5 miles (5632-15288 meters) (Figures 2 and 3). In the event that deposition were predicted outside the IRZ, the Zone D grid system should be extended out until the area has been incorporated into the grid system. The density or number of samples collected will vary within these zones. The closer the zone is to the initial release site, the greater the number of samples or from a statistical standpoint the less room for error. Zone D will encompass the outer fringes of the deposition area where CWA concentrations would be expected to be the lowest.
- (3) Soils. The number of soil samples that will be collected will be dependent on the zone from which the samples are to be collected. The IRZ having been divided into four zones will be subdivided into triangular grids to identify specific sample points. The distribution of CWA deposited will vary the greatest nearer the initial release point. As one moves away from the release point, CWA will be more evenly deposited over a greater area. Hence, the sampling grids will be smaller nearer the release point. Table 1 lists the grid sizes for each zone. The grid sizes were selected to ensure that the chance of missing CWA is minimized. Plumes will distribute CWA typically in a semielliptical patterns over a large area. The length and width of the plume will vary with the environmental conditions and CAI. Hence, the size of the grid will determine the likelihood of finding various CWA deposition 'hot spots' (reference 12). Table 1 also lists the confidence level for detecting and 'hot spot' with the listed dimensions. 'Hot spots' of smaller dimensions may also be detected with the listed grid sizes. However, the confidence level for finding smaller areas of deposition decreases with their respective size.

Table 1. Sampling Grid Dimensions.

Area	Grid Size (meters)	Deposition Area (meters) <sup>1</sup>	Confidence Level (%) <sup>2</sup>
Zone A	201	301 x 160	90

Zone B	402	602 x 321	90
Zone C	805	1203 x 642	90
Zone D	1609	2406 x 1284	90

- 1 Deposition area is defined as an elliptical hot spot with the long axis being 75% and the short axis being 40% of the grid length (reference 12).
- 2 Confidence Level, likelihood of sampling efforts to identify deposition area of given size.
- (4) Wipes. The number of wipe sample locations will be dependent on the number of building structures located within each of the four zones. This number will be based on proportions. This is an estimation of the percentage (proportion) of the population which possess or does not possess some given property (reference 13). In this case, we are concerned whether or not any CWA contamination exists and, if so, how much. The number of sample locations within each of the zones is determined using the proportions calculation. Several variables exist within this equation. The values of these variables dictate or translate into acceptable error. The more conservative they are, the less chance for the sampling to be inadequate. The variables used are listed in Table 2. For example purposes, 100 structures were assumed per area. Table 2 displays the number of locations that would need to be sampled to properly assess the CWA contamination (if any) with the given assumptions. Equation 1 is used to determine the number of sites to sample:

$$n = [N(Z_{1-\alpha/2}^2/)^2)P(1-p)]/[(N-1)+(Z_{1-\alpha/2}^2/)^2)P(1-p)]$$
 (1)

n = sample size (fractions rounded up)

N = Population Size

P = population proportion (assumed worst case = 0.5)

p = sample proportion (assumed worst case = 0.5)

 $\Delta$  = amount of error (precision) allowed in p estimate of P; error = /P-p/

 $\alpha$  = probability allowed that error will exceed  $\triangle$  (confidence level)

 $Z_{1-\alpha/2}$  = standardized normal deviate for an area totaling " at the tails

Table 2. Zone Wipe Sample Locations Determination.

Area	Grid Size (meters)	α (%)	Δ (unitless)	Structures Sampled within Zone(%)
Zone A	201	95	0.10	50
Zone B	402	95	0.20	20
Zone C	805	90	0.20	15
Zone D	1609	80	0.20	10

Based on these values, 50% of the structures will be sampled in zone A, 20% in zone B, 15% in zone C, and 10% in zone D. For sampling purposes, all structures regardless of their size are equal for counting purposes. Two wipes sample should be collected per structure. One sample will be collected outside of the structure, and the second wipe should be collected inside the structure. These should be collected from smooth surfaces which are considered nonporous such as glass, kitchen countertops (tile), and/or exposed metal. Wipe samples collected from porous materials may underestimate CWA surface concentrations due to absorption. Samples collected from materials other than glass or metal may be dissolved by the collection solvent when trying to collect samples. Outside samples should be collected from surfaces that face the direction the plume originated. Indoor samples should be collected from area located near open windows, ventilation ducts, door cracks, etc. Samples nearer the floor and in rooms where children might spend the most time would be ideal. Vehicles located at households and commercial stores should be considered as an extension of the structure, hence a potential sampling point (both indoor and outdoor).

(5) Air. The number of air samples to be collected will be dependent on the number buildings and structures, as were the wipes. The sample technique that was used for determining the number of wipe samples should be used to determine the number of air samples that are to be collected using Equation 1. In this case though, the population number (N) to be used is the number of structures that were to be wipe sampled. Table 3 details air sampling requirements based on the wipe sampling requirements listed in Table 2.

Table 3. Air Sample Size Determination.

Area	Grid Size (meters)	α (%)	∆ (unitless)	Structures Wipe Sampled within Zone (%)	Structures Air Sampled within Zone (%) *
Zone A	201	95	0.10	50	25
Zone B	402	95	0.20	20	10
Zone C	805	90	0.20	_15	7.5
Zone D	1609	80	0.20	10	5

<sup>\* -</sup> Structures selected for air sampling should be from those which were wipe sampled.

(6) Surface Water. Surface water sites that will be sampled will be determined in the same manner as wipes using Equation (1). Based on these numbers and what zones are involved, some percentage will be sampled. The number of samples to be collected at these sites will be dependent on the size of the site and the type of water it is, lentic or lotic. Each grid that a surface water site extends into will count as 1 site. A river passing through 20 grid areas would be 20 sites. For each lotic water site, samples should be collected downstream this distance equaling approximately 5 times the width of the waterway. This will approximate surface water transportation of CWA away from the deposition area to areas potentially outside the impacted grid area. Table 4 provides examples for water sample site

determination and location.

Table 4. Surface Water Site Sample Determination.

Examples	# of Grids Found In (Total Sites)	Type of Water	Potential Number of Samples	Width of Waterway (meters)	Distance Downstream Samples are to be Collected from Each Site (meters)
River	20	lotic	20	305	1524
Stream	5	lotic	5	1.5	7.6
Pond	2	lentic	2	N/A	N/A
Marsh	6	lentic	6	N/A	N/A

- (7) Miscellaneous. The number and types of miscellaneous samples will be dependent on a variety of things (terrain, field reports, sensitive populations, crops, etc.) When and where to take these will be dependent on their proximity to the release and location within the sample grid system.
- (a) Terrain. Unique terrain features such as gullies, ditches, and valleys which may serve as vapor collection points or conduits for plume passage should be sampled. Field reports which indicate the passage or presence of CWA should be reviewed. Reports coming from outside the sample grid should be immediately investigated to determine whether the grid should be active or incorporated into the grid system itself. This is crucial since the computer model is only a prediction.
- (b) Sensitive Populations. Sensitive populations (day care centers, hospitals, schools, etc.) should all be located within and immediately around the IRZ. When these locations are within a grid requiring sampling, these locations should be identified as one of the sample points. Sensitive populations located outside of the activated grids may be considered for additional sampling if located near the buffer zone or further downwind outside of the predicted plume deposition area. In these instances we are purposefully biasing are sampling to those populations with the greatest risk.
- (c) Biological. Biological samples (agricultural products, wildlife, etc.) will be collected as needed. Animals which are dead or behaving out of the ordinary and plants which are discolored or wilted should be considered for sampling. The primary purpose of this type of sampling is to clear areas of CWA deposition identify potential 'hot spots.' Deposition areas which are identified as commercial agricultural areas will not be sampled with the intention of clearing the material for resell and human/animal consumption. Scheduled sampling efforts may ultimately satisfy this requirement, however, the site manager will not make this determination. Health and safety officials will evaluate the 'complete' release event and make the final determination.

#### d. Sample Collection.

(1) Soil. Soil samples are to collected from within ±100 feet of the grid coordinate. Grid points can be found using an Enhanced Precision Lightweight Global Positioning Satellite (GPS) Receiver (EPLGR). This will allow field personnel to identify sample locations to within ±5 feet. When selecting the specific sample point, the site should be free/devoid of surficial matter such as leaves, twigs, or any other organic matter, open bare ground being ideal. Any organic matter in the sample may adversely affect laboratory analyses. Soil samples are collected using a stainless steel scoop or spatula. Using the scoop or spatula, scrape and collect surface soil to a depth of no more than 1 inch. Place the sample directly in the sample container. Collect a sufficient sample such that there is no head space in the jar. Then, tightly close and label the container. Table 5 lists sample collection requirements. Do not collect and mix the sample prior to placing in the sample jar. Mixing may release CWA from the sample skewing sample results to the low side.

Table 5. Sample Collection Requirements.

Media	Container	Volume Required	Preservation	Maximum Holding Time (days)
Soil	4 oz glass bottle with Teflon™ lined cap	2 x 100 g	4 °C	7
Wipe	40 mL glass bottle with Teflon™ lined cap	2 x 1 Wipe A	4 °C	7
Water	100 mL amber glass Water bottle with Teflon™ lined cap		pH < 2, 4 °C	ASAP
Air	Air Bubbler	TBD	4 °C	ASAP
Biological	CWA Impermeable Plastic Bag	n/a	< 0 °C	14

A - Collection solvent: Methanol

References 14, 15, and 16.

(2) Wipes. Wipe samples are collected using an acrylic swab soaked with collection solvent (see Table 5). Using tongs, the swab is swiped across a 10 cm by 10 cm area using an up-and-down motion (reference 17). The swab is then swiped across the area using a side-to-side motion and is then placed in a 40-mL vial, sealed, and sent to the laboratory for analysis. The area to be swiped is typically measured using a pre-cut template of the required sample dimensions. Suggested wipe sampling points are listed in Table 6. Wipe samples should not be collected from an area that was sampled previously.

If multiple samples are required from one location, these should be collected from adjacent areas.

Table 6. Suggested Wipe Sample Locations

Locations	
Automobile Windshields	
Window Panes	
Kitchen/Bathroom Sinks/Bathtubs	
Kitchen/Bathroom Countertops	(Tile Only)
Ventilation Ducts/Outlets	

- (3) Air. Air samples will be collected by trained, certified technicians. The methods to be used are prescribed in DA PAM 385-61 (reference 5).
- (4) Surface Water. There are two types of surface water lentic (slow moving) and lotic (fast moving). As such, there are two separate collection procedures. Surface water samples may be collected in two forms. Obviously, water can be the sample media collected. The other means for evaluating surface water would be the collection of sediment samples.
- (a) Lentic Sites. Water samples collected at lentic water sites should be collected from shallow water areas located at the edges of the site. The sample container should be lowered into the water to allow water to flow into the sample container with as little disruption to the site as possible. The shallow areas of the site should be less turbulent (convection currents) then the deeper areas of the site and may extend the half life  $(t_{1/2})$  of the CWA. With less mixing, CWA and their breakdown components may stratify concentrating in various layers. By sampling at the edge, we should be sampling the most accessible and likely layer.
- (b) Lotic Sites. For lotic sites, water or sediment samples can be collected. Water samples should be collected in the same manner as lentic water samples, at shallow, 'calm' locations along the water. In lieu of water, sediment samples can be collected. These should be collected at the same locations as would a water sample. Using a scoop, sediment from along the edge of the water line should be collected to a depth of no more than 1 inch until sufficient sample has been collected to fill the sample container. Sediment samples should not be mixed prior to filling the sample container.
- (5) Miscellaneous. Miscellaneous samples will probably fall under one of the above categories for collection purposes. Some exceptions might be snow and biological materials such as leaves, insects, fish, etc. Though these types of samples may be desirable for certain assessment purposes, be aware that analytical capabilities may be particularly limited. In addition there are no standard criteria/methododolgies for assessing the 'significance' of risk to or from of these types of 'special media' and if attainable -these results will generally require a very detailed risk assessment. Such samples should only be taken if deemed absolutely necessary (to answer key public health concerns).

- (a) Biological. Sampling for biological material (e.g. birds, insects, small mammals, leafy plants) will for the most part simply be collecting the specimen and placing it within a sample container. Preferably, samples are collected using tongs or some other grabbing device and placed in a CWA impermeable bag. The bag should be sealed with a minimal amount of headspace and then immediately iced to prevent any further degradation due to biological or microbial activities.
- (b) Snow. For some stockpile sites, there is a strong possibility that the CAI may occur when snow is present or being deposited on the surface. In this event, soil and wipe sampling may be rendered unnecessary since the surfaces that would normally be sampled would be covered. Is this event, rather than collect soil or wipe samples, snow samples are to be collected in their place. If the CAI occurs during a snow event with no previous snow deposition, snow cores with a 3 inch diameter should be collected. If the depth of the snow is insufficient, additional cores should be collected until the sample container is full. If snow was present prior to the CAI, collect snow from the top 2 inches (or less) until the sample container is full.
- e. Extreme Climatic Conditions. In the event of an CAI which is caused by an extreme climatic condition such as a tornado, hurricane, rainstorm, etc., sampling activities will initially be limited to Zone A of the grid system. If field reports indicate the presence of CWA outside of Zone A, and depending on the number of field reports, those grids can either be incorporated into the sampling scheme or, if sufficient field reports are confirmed, Zone B become activated. Models for air dispersion and soil deposition will not be able to accurately model these events. The sampling approach for these types of CAI will be a wait and see, with limited sampling unless until otherwise indicated.
- f. <u>Collection Priorities</u>. The priority in which samples are collected and analyzed for CWA presence will be dictated by human health considerations (emergency evacuation), CWA confirmation, and area reentry. Table 7 lists the recommended priority. Initially, the boundaries of release should be confirmed followed by the clearing of emergency evacuation routes. This should then be followed with the sampling of confirmed/suspect field reports of CWA outside the grid boundary. From this point, sampling should be conducted such that the grid collapses upon itself. Identified 'hot spots' will be left for further evaluation upon the completion of the recovery sampling efforts. This sequence of priorities will allow for the most expedient 'clearing' of zones for general reentry.

Table 7. Recommended Sample Collection Priority.

Priority
Deposition Area Perimeter (Outer Grid Vertices)
Emergency Evacuation Routes/Areas (Required samples, all matrices)
Field Reports of CWA Outside Initial Active Area
Wipes
Deposition Area Interior (Inner Grid Points)
Air Samples

Surface Water	_	 		
Wastes				

Note: The priority in which miscellaneous samples will be collected will be dependent on the matrix and location of the site to be sampled. The site manager will prioritize these samples.

- g. <u>Field Quality Assurance/Quality Control (QA/QC) Procedures</u>. Field splits and duplicates should be taken to ensure sampling and laboratory quality control. These QA/QC samples should be collected in addition to the scheduled samples. The number of collected should equate to approximately 7 percent of the total number samples collected for both splits and duplicates. Field splits and duplicates will not be collected for biological samples such as animal carcasses. These should be further defined within the quality assurance project plan.
- (1) Field Splits. Split samples are collected by dividing the sample in half. These halves are then submitted as two distinct analyses. Split samples results can be used to evaluate sample collection technique. Note: Split samples are not collected for wipe samples.
- (2) Field Duplicates. Duplicate samples are collected by sampling two locations which are immediately adjacent to one another. Duplicate sample results can be used to evaluate the homogeneity/distribution of contaminants within the given media.
- h. Data Quality Objectives (DOO). The DOO define whether sampling efforts have adequately identified and addressed necessary questions and concerns. In essence, the primary goal of sampling is to determine whether or not CWA/breakdown components are present at a concentration of predetermined significance ('significance' meaning of potential health concern). This 'significance' is based on the statistical parameters and degree of 'confidence' described above. The statistical DQOs should be determined and documented in the RSAP before sampling is implemented. Once QA/QC on both field and laboratory activities have been evaluated, any suspect analytical data will be evaluated on a case by case basis in order to determine whether the data should be qualified, the original samples should be reanalyzed, or in some cases, the site re-sampled. Once all 'valid' data is identified, the DQOs described in here and in the RSAP must be 'checked' to ensure that enough sample data was still available to achieve the desires confidence level. In essence, this will be a pass/fail excercise. Data from each grid will be evaluated for OA/OC performance and compared against current health-based screening levels (HBESL) (reference 7). Grid areas which are 'positive' (results above HBESLs) or questionable data will considered 'hot spots', remain active and quarantined for further evaluation. Results for grid areas where all analytical data fall below HBESL and and pass QA/QC review will be reviewed areas with sound data will be forwarded to the site manager for review and consideration for deactivation of the grid.

#### 10. ANAYTICAL/LABORATORY REQUIREMENTS.

a. <u>Analytical Methodologies</u>. Analytical laboratories will not be directed to which method(s) they should use. Rather, detection limit goals for CWA and associated breakdown compounds will be given.

Table 8 lists the detection limit goals. These are based on the most conservative HBESLs established for chemical agents (reference 7). Tables 9 and 10 identify the key CWA breakdown components associated with each chemical agent and the associated detection limit goals for those breakdown compounds (also based on information and HBESLs described in reference 19). In the likely event that the selected laboratories do not have methods in place for the various matrices, an evaluation of the 'best' methods available (to include assessing alternative laboratory services) must be performed. To facilitate this process, the U.S. Army is currently compiling a "Compendium of Analytical Methods for Military Chemical Agents and Associated Compounds" (reference 18). When completed, laboratories/activities which need to identify procedures for specific CWA and/or breakdown components can search the compendium in order to preclude developing an already existing method or ascertain whether a method exists as all. In certain cases, it may be identified that these very conservative 'goals' cannot be met by any attainable laboratory support. In other cases, very limited support (only a few samples) may be reasonably analyzed to such levels. This is particularly important to identify before a CAI occurs so that appropriate negotiations and decisions can occur regarding 'acceptable' goals and numbers of samples.

Table 8. Analytical Detection Limits -Goals for Stockpile CWA in Various Environmental Media.

Media	GB	VX	HD	L	Notes
Soil/Sediment/B iologicals (mg/kg)	0.75	0.025	0.15	3.8	
Water (µg/L)	0.36	0.011	2.1x10 <sup>-5</sup>	1.8	
Air (mg/m³)	1.5x10 <sup>-6</sup>	1.5x10 <sup>-6</sup>	5x10 <sup>-5</sup>	0.0015	
Wipe (μg/100cm²)	0.075	0.0022	1.7x10⁴	0.37	

References 7 and 19.

Table 9. Selected Key Breakdown Products of Chemical Agents.

Table 9. Selected N	Ley Breakdown Products of Chemical Agents.	
Abbreviation	Name	Parent Compound
TDG	Thiodiglycol	Sulfur Mustard
MPA	Methylphosphonic Acid	GB, VX
ЕМРА	Ethyl Methylphosphonic Acid	VX
IMPA	Isopropyl Methylphosphonic Acid	GB
EA2192	S-(2-diisopropylaminoethyl)methylphosphonic Acid	VX
Lewisite Oxide	2-Chlorovinyl Arsenous Oxide	Lewisite
Arsenic	Inorganic Arsenic	Lewisite

Notes: Compounds selection was determined using reference 20.

Table 10. Analytical Detection Limits Goals for Selected - Breakdown Components of CWA in Various Environmental Media.

Media	TDG	MPA	ЕМРА	IMPA	EA2192	Lewisite Oxide	Arsenic
Soil/Sediment/ Biological (mg/kg)	50 A	500 A	50 <sup>A</sup>	200 <sup>A</sup>	0.01 <sup>B</sup>	7.7 <sup>c</sup>	0.38 <sup>D</sup>
Water (µg/L)	10 A	100 <sup>A</sup>	10 A	50 A	0.010 <sup>B</sup>	3.7 <sup>c</sup>	190 <sup>E</sup>
Air (mg/m³)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Wipe (µg/100cm²)	10 <sup>A</sup>	100 A	10 <sup>A</sup>	50 <sup>A</sup>	0.05 <sup>B</sup>	0.75 <sup>c</sup>	in developm ent

A - reference 15

B - reference 16

C - reference 7

D - reference 21

E - reference 22

b. Quality Assurance/Quality Control. Quality Assurance and quality control are a means of monitoring and assessing the quality of the data. These assess the ability of the laboratory to perform prescribed methodologies and whether the methods themselves accurately measure contaminant concentrations in the specific environmental media (soil, wipes, air, surface water, biological, snow). By assessing the laboratories and methodologies they use, the data that is generated will be easier to defend if challenged in any way. The laboratories which are contacted in preparation of the sampling plan should include their Quality Assurance Manual (QAM) or Quality Assurance Project Plan (QAPjP) as an appendix in the sampling plan. The QAPjP should detail the Quality Assurance Program within the laboratory. Table 11 lists some of the specific components of the program. Details for their preparation can be found in the EPA Requirements for "Quality Assurance Project Plans" (reference 23). A second/independent laboratory should be used to analyze field duplicate samples at a rate of 5% of the total samples taken. The sample points selected for collection of field duplicates should be determined randomly. The QAPjP will define the QA/QC parameters used for assessing the quality of data generated from a single lab and for comparing data between multiple laboratories for precision,

accuracy, representativeness, completeness, and comparability (PARCC). Before used in a site evaluation, analytical data will first be assessed using the PARCCs listed within the QAPjP. This will establish the validity of the data and determine whether or not any of the data is suspect.

Table 11. Components of a Quality Assurance Manual/Program.

QAM/QAPjP Sections
Quality Assurance Policy
Data Quality Objectives for Each Method
Chain-of-Custody (CoC) Procedures
Preventive Maintenance Schedules/Documentation
Data Management (reduction, validation, review, reports)
Instrument Calibration Procedures
Corrective Action Procedures
Performance/System Audits
PARCC - precision, accuracy, representativeness, completeness, & comparability
Quality Control Procedures

#### 11. FIELD ACTIVITIES - SPECIFIC PROCEDURES AND RESPONSIBILITIES

- a. Schedule. The time lines for execution of a sampling plan will be entirely dependent on the size of the CAI, location of the stockpile site, and the number of field and laboratory personnel utilized. Essentially, sites located in remote areas will require fewer samples to be collected primarily due to the lower population density in those areas. This results in fewer wipe and air samples. More populated areas will require a higher number of wipes and air samples. Ideally, an RSAP for a 'small' release could be implemented and executed in several days, a 'large' release in one week. Again, time lines will vary due to population densities. The bottleneck for any CAI operation will be the laboratory. Environmental samples can only be processed (extracted and analyzed) so fast. This is due to the time required for extracting the CWA/byproducts from the matrix, the time required to analyze the extracts, and to the maintenance and quality control procedures needed to ensure accurate analyses. Hence, sampling activities may be completed long before all analyses are complete. Sample collection prioritization should include prioritization of analyses in order to facilitate the deactivation of grid areas.
- b. Responsibilities. The site manager and field technicians will be responsible for placing the samples in the sample containers. The site manager will ensure that the samples are properly labeled, preserved, stored, and shipped to the laboratory. He will also be responsible for ensuring the proper CoC is maintained. The field technician will be responsible for obtaining the samples and decontaminating any nondisposable sampling equipment. The order of sampling will be determined by the site manager as dictated by field reports and sampling priorities as outlined in the Collection

#### Priorities Section.

- c. <u>Sample Handling and Management</u>. Field personnel will place all samples for laboratory analyses in containers at the sample site. Labels will be affixed with a sample identification number, date and time sampled, and with the name of the field personnel collecting the sample using an indelible pen. The sample numbering scheme should identify the grid point or grid from which the sample was collected as well as identify the location within the grid from the where the sample was collected (e.g. W0240001, wipe sample number 1 from grid 24). Samples will be placed into coolers filled with ice to maintain a temperature of  $4\pm2$  °C. Field personnel will record appropriate field observations in a permanently bound field notebook. All samples will be shipped directly to the laboratories for analyses.
- d. <u>Record Keeping</u>. Detailed notes will be maintained by the site manager and field technicians. This will include sample locations (as determined by the EPLGR), sample identification number, date and time collected as well as any other relevant observations (i.e. dead animals, discoloration, residue). An inventory of samples should accompany each cooler of samples delivered to the laboratory with any other appropriate instructions.
- e. <u>Chain-of-Custody</u>. Chain-of-Custody starts in the field. Once samples are collected, a detailed paper trail will be established documenting who and when individuals who had possession or controlled access to the samples. This will be maintained from the time of collection until all analyses have been completed. An CoC program is necessary to control access to the samples in order to ensure that samples are not tampered with by persons unknown and that the samples are properly stored and handled during the recovery operation. A CoC standing operating procedure should be written and included in the QAPjP.
- f. Resources. In order to implement the RSAP effectively, necessary resources will need be coordinated ahead of time. The QAPjP will identify the laboratory requirements for the anticipated sample load and expected turn-around-times (TAT). In order to meet the TAT, samples will need to be collected quickly and efficiently. Sample personnel and equipment will need to programed. The time needed to collect one sample will be approximately 15-30 minutes (10-15 minutes for collection:10-15 minutes for locating and identifying the sample point). Based on the likely scenario and approximate collection time, the number of sample teams and supporting equipment needed can be programed.
- g. <u>Decontamination Procedures</u>. One or more excursion zones should be set up for persons exiting active cells. Entry and exit of active areas should be strictly controlled. At these exit points, a decontamination line should be established, whereby, all persons exiting the active area are thoroughly decontaminated using standard U.S. Army procedures as detailed in the site specific Site Safety and Health Plan. Personnel who collect samples may, as a result of sampling activities, become contaminated themselves. Equipment used to collect samples may also be contaminated due to having been in direct contact with the sample. All sampling equipment and personal protective equipment (PPE) used in the collection of samples should be collected and turned over to the U.S. Army for proper treatment and/or disposal. Personnel should not attempt self decontamination while in the field.

- h. Waste Management and Disposal. All materials used to collect samples should be disposable, if possible. This will include both PPE and sample collection equipment. This will minimize the need for decontamination of items and significantly reduce the amount of decontamination solution and rinsate that is generated. Once used, all PPE and disposable sampling equipment will be stored in agent-tight containers. If after all sample analyses have been complete none of the samples indicate the presence of CWA, all wastes generated during collection activities can disposed of in a subtitle D landfill or as general nonhazardous waste Wastes associated with samples which test positive for the presence of CWA will need to be will be turned over to U.S. Army officials for proper disposal.
- 12. DATA EVALUATION. Once the quality and acceptability of the data have been determined, the data is evaluated against pre-established chemical agent HBESLs (reference 7). Screening levels or Preliminary Remediation Goals (PRGs) have also established for various industrial contaminants to including arsenic, in soil (references 21) and water (reference 22). Through use of the same EPA health risk modeling methodologies and currently DA-Office of the Surgeon General approved toxicologic reference doses (reference 24), the DA [has] established HBESLs for chemical agents and key breakdown products of concern. The HBESLs are established for various types of situations such as contamination in a residential area (where children may be exposed) or in an area where only adult workers may be exposed. Ideally, site-specific health risk assessments should be used to determine the actual degree of significant health impacts. However, use of the HBESLs and associated guidance provided in reference 7 will facilitate initial baseline screening determinations regarding action or nofurther action (to include detailed assessment, management controls, and /or remedial efforts). The siteevaluation may initially focus on use of the conservative numbers presented in reference 7 but consultation with the USACHPPM, Environmental Health Risk Assessment (HRA) and Risk Communication Program is required (reference 25), commercial 410-671-2953 (DSN 584-2953) to ensure appropriateness of the HRA determinations.

## 13. OTHER PROJECT MANAGEMENT REQUUIREMENTS.

- a. <u>Organizational Roles and Coordination</u>. Should changes be necessary to the RSAP once field sampling activities have been initiated a process of change should be identified, particularly identifying who has what decision authorities, etc. For example, Table 7 details a recommended order for prioritizing sample and analyses activities. Events in the field or specific stockpile site characteristics may dictate that the specific samples be processed outside of the given recommendation. On these occasions, the site manager has the sole authority for altering or implementing an alternate prioritization scheme
- b. <u>Supplies</u>. At a minimum, the quantity of sampling and PPE supplies maintained should be sufficient to supply a response to the most likely scenarios. If a CAI were to occur which would require additional supplies, these will be obtained from one or more of the other stockpile sites. Some of the items which will be required have expiration dates, these typically being chemicals. Therefore, those items should be inspected and replaced when necessary. Otherwise, expired supplies may adversely

impact analytical results possibly resulting in false positive/negatives necessitating that sites be resampled.

- c. <u>Site Safety and Health Plan</u>. A Site Safety and Health Plan (SSHP) should be prepared in conjunction with the RSAP. The SSHP will delineate the responsibilites of individuals present during the execution of the RSAP and will also identify all potential hazards (biological, chemical, and physical) associated with the execution of the RSAP. Other items which should be addressed within the SSHP are personnel protective equipment, decontamination procedures, personnel training, site control measures, and emergency procedures (rendering first aid, who to notify, etc.).
- d. <u>Data Interpretation and Release</u>. All analytical data and related conclusions and recommendation will only be released with the approval of the site manager. Based on the information generated from the sampling activities, the site manager will determine when an active grid area can be deactivated. And if necessary, designate which active grids will be quarantined until a more site specific health risk assessment can be completed. Current HBESL will be used to determine which active grids are to be deactivated or quarantined. Areas which are quarantined will be evaluated for the level of reentry which will be allowed.
- e. <u>Decision Documentation</u>. A detailed account of information and specific actions and decisions should be maintained throughout the entire recovery operation. This documentation will detail the why's and when's of decisions made. It may be in the format of a continuously updated document or a compilation of notes, memos, etc. This should include how the field reports are handled, how the various active grid areas are deactivated/quarantined, and sample prioritization. This will facilitate any afteraction review board investigations/inquiries that will follow any CAI event and serve to improve the process in the unlikely event of additional CAIs. The site manager maintains the sole responsibility for preparing the required documentation.
- f. <u>Risk Communication</u>. Risk communication will be vital to keeping the public informed of the progress of the recovery efforts as well as in explaining how or why certain approaches were taken with regards to sampling. The Installation Commander will ultimately be responsible for keeping the public informed. This should include discussion on why samples were collected at specific sites and not others, how models work, HBESLs and what they mean, and how active, quarantined, and deactivated grid areas are defined. Specific assistance on training and consultative assistance on Risk Communication can be acquired by contacting the USACHPPM Environmental HRA and Risk Communication Program (commercial 410-671-2953).

#### SECTION III

#### 1. EXAMPLE SITE INCIDENT AND RSAP INFORMATION

a. <u>Introduction</u>. The release scenario detailed in the 'Pine Bluff CSEPP Exercise 1997' (reference 6) will be used as an example in the demonstration of the use of the protocol. In this scenario, 2,232 VX, M55 rockets are consumed in an igloo fire over the course of several hours. All agent is either

consumed or released. The plume from the fire/agent release moves south. This scenario has been described as a 'worst of the worst' rather than as a likely scenario.

- b. <u>Site Description</u>. In this scenario, the D2PC model (reference 9) indicated the VX plume traveled south of the installation for over of 30 miles. The GapCap model determined that VX deposition occurred over an area extending several miles. The deposition area impacted IRZ zones A and H. The outskirts of the town of Whitehall fall within the deposition area. Located within these areas are upwards of 10,000 persons and several thousand building structures. Houses are typically one-story family homes with small business intermixed at various locations. Within these areas are approximately 20 sensitive populations (schools, hospitals, day care facilities, etc.). There are also approximately 15 water locations within the deposition area. The largest of these measuring about 61 m by 152 m. The entire area is moderately covered with ground vegetation and trees. There is one major stream (Caney Bayou) whose course passes through the deposition area. The Arkansas River and several small lakes (Tulley and Yellow) are located to the east of Pine Bluff Arsenal, but are located outside the modeled deposition area. The lakes are situated on a bluff overlooking the Arkansas River flood plain. There are no major ravines or valleys which would significantly alter or direct wind flow.
- c. Sample Summary. Figure 4 depicts the grid areas which would be considered active based on the above scenario. Figures 5-8 demonstrates the process on how the process might evolve as sampling/analysis progressed. Figure 5 shows the activated grids without the plume. As time progresses, outer grids are deactivated effectively beginning the collapse of the 'bubble" (Figure 6). Also displayed are activated grids outside the immediately impacted area. Field reports indicated possible CWA passage warranted activation and hence sampling of these areas. Figure 7 displays further collapse of the bubble. Finally, all activated grid areas have been sampled leaving behind only those areas ('hot spots') which yielded analytical results above the screening guidelines (Figure 8). Table 13 lists the approximate number of wipe, air, water, and miscellaneous samples that are to be collected in each of the four zones. The number of soil samples was determined by roughly overlying the grid with the modeled deposition area. The number of grid vertices within the deposition area and grid vertices located within 805 meters of the deposition area were counted. The number of wipe samples was determined using equation (1) and 1990 census data for IRZ areas A and H. The number of households from these given IRZ areas were determined using an estimate of the total areas of A and H which fell within the deposition and buffer zones. Air samples were determined by simply taking 50 % of the total number of buildings/structures which were to be sampled. Water and sediment sites were determined by reviewing U.S. Geographical Survey (USGS) maps for water features located within the deposition and buffer zones. The number of miscellaneous samples was merely an estimate. A more thorough review where the number of buildings/structures and water locations are identified for each specific grid or zone would generate more accurate numbers.

Table 13. Approximate Number of Environmental Samples per Zone.

Zone	Soil	Wipes	Air	Water	Miscellaneous

CSEPP Recovery Sampling and Analysis Plan Protocol for CWA Accidents/Incidents

A	61	20	5	3	25 Total
В	28	50	13	3	for All Zones
C	21	102	26	3	
D	24	414	104	3	
Total	134	586	148	12	25

Note: All sensitive populations located within the grid areas would be wipe sampled. Additional wipe samples could be collected at sensitive population locations in non-impacted areas via miscellaneous sampling.

- 2. IMPLEMENTATION. The individual CSEPP stockpile sites will be responsible for several items within this protocol necessary to transform it into a complete Sampling and Analysis Plan SAP). The estimated time for completion of the RSAP is 9 months. Once completed, each stockpile site should seek approval of the RSAP and QAPjP from the State and Regional EPA offices. The RSAP and QAPjP should be reviewed and updated on a yearly basis in order to reflect changes in the local communities, CWA maintained, analytical methodology advances, and changes with the HBESLs.
- a. <u>Scenarios</u>. 'Likely' scenarios will need to be developed to facilitate sample supply acquisition and laboratory selection (section 2). Using these scenarios, recovery operation teams will be better prepared for what to expect with regards to sampling activities. The grids which would be activated under the mostly likely scenarios should be reviewed in order to determine the number of soil, wipe, air, and water samples that could be potentially collected. This will require a thorough count of the building/structure and water locations within the likely scenario grid areas. These will provide a basis from which an estimate on the number of samples that will be collected and hence the amount sampling supples that should be maintained. Estimated time to complete: 1 month.
- b. <u>Topography</u>. Distinct geological or surface features which may impact or direct the flow of plumes should be identified (mountain ranges, hills, canyons, forests, cities, etc.) (Section 6.b). This would include identifying surface water features. These should be restricted to rivers, major streams, reservoirs, lakes, commercial activities, and recreational points. These points need to be identified in order to determine which grid areas contain surface water locations. Geological and surface features are identified as possible miscellaneous sample locations. Estimated time to complete: 1 month.
- c. Grid Overlay. Using the recommended grid sizes or site specific preferences as determined by the each CSEPP working group, the IRZ will need to be overlaid with a grid (section 9.c). As stated, the sizes of the grid used will determine the level of confidence for detecting/finding a deposition area of an unknown size. The model used to predict both the plume and deposition may change in the future. Use of these should not affect the use of a grid overlay. Future models may predict plumes and deposition patterns unlike the 'cigar' shaped predictions illustrated here. Rather, pockets of grid areas may be activated based on these more 'accurate' models. Estimated time to complete: 1 month.
  - d. Buildings. The most recent census should be used to approximate the number of

buildings/structures located within the grid areas (section 8.d.2). Known new construction of special buildings such as schools, day care facilities, and retirement communities should also be included. These numbers will facilitate recovery operations for determining the number of samples to take per grid area, if ever required. These will also to serve to give a better estimate of the amount of sampling supplies required to have on hand and what capabilities the laboratory will need to maintain. Estimated time to complete: 2 months.

- e. <u>Laboratory</u>. The laboratories which will be conducting the analyses will need to be determined (section 8.h). The selection of a laboratory should be dependent on their being able to handle the specific samples loads associated with the 'likely scenarios.' It will also be dependent on their ability to perform the necessary methodologies associated with the matrices anticipated and the detection limits goals listed in Tables 8 and 10. Estimated time to complete: 5 months.
- f. Quality Assurance Project Plan. The laboratories which are selected in preparation of an CAI should be responsible for the preparation of the QAPjP (section 10.b). The contents of the QAPjP will pertain primarily to laboratory operations and should be prepared in accordance with EPA guidelines. Hence, they will be most familiar with their own operations and procedures. Estimated time to complete: 9 months.
- g. <u>Supplies</u>. Sampling supplies will need to be stockpiled in preparation for an CAI (section 13.b). The quantity kept on hand should be sufficient for use with the likely scenarios. In the event that additional supplies are needed in an CAI crisis, supplies should be obtained from one or more of the other stockpile sites. Some of the items which will be required have limited shelf lives and/or may deteriorate over time. Hence, these items should be replaced at frequencies such that these items usable at all times. Estimated time to complete: 5 months.

#### APPENDIX A

#### References

- 1. CSEPP Planning Guidance, Appendix M Planning Guidelines for Recovery Phase Activities for the Chemical Stockpile Emergency Preparedness Program, May 1997.
- 2. Army Regulation 50-6, Chemical Surety, February 1995.
- 3. DA Pamphlet 50-6, Chemical Accident or Incident Response and Assistance (CAIRA) Operations, May 1991.
- 4. Army Regulation 385-61, The Army Chemical Agent Safety Program, February 1997.
- 5. DA, Pamphlet 385-61, Toxic Chemical Agent Safety Standards, March 1997.
- 6. Chemical Stockpile Emergency Preparedness Program, Pine Bluff Community Exercise 1997 26-27 February 1997, 22 February 1997.
- 7. Oak Ridge National Laboratory, DRAFT Exposure Assessment and Derivation of Environmental Screening Levels for Chemical Warfare Agents, prepared for U.S. Army Center for Health Promotion and Preventive Medicine, April 1998.
- 8. Oak Ridge National Laboratory, Baseline Sampling Position Paper for the CSEPP Community, DRAFT, Feb 1998. U.S. Army Chemical Research, Development and Engineering Center, Personal Computer Program for Chemical Hazard Prediction (D2PC), CRDEC-TR-87021, January 1987.
- 9. U.S. Army Chemical Research, Development and Engineering Center, Personal Computer Program for Chemical Hazard Prediction (D2PC), CRDEC-TR-87021, January 1987.
- 10. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final, EPA/540/1-89/002, December 1989.
- 11. U.S. Army Chemical Research, Development and Engineering Center, Expedient Sheltering In Place: An Evaluation for the Chemical Stockpile Emergency Preparedness Program, ERDEC-TR-336, June 1996
- 12. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Removal

Program Representative Sampling Guidance, Volume 1 - Soil, Publication 9360.4-10, November 1991.

- 13. Army Materiel Systems Analysis Activity, October 1985, Interim Note No. R-85 (revised) Statistical Guide for Sample Data Collection (SDC) Planning.
- 14. U.S. Army Center for Health Promotion and Preventive Medicine, Directorate of Laboratory Sciences, Internal Guidance.
- 15. Quanterra Inc., Analytical Reporting Limits for Select CWA Breakdown Components, February 1998.
- 16. QuickSilver Analytics Inc., Analytical Reporting Limits for CWA and EA2192, February 1998.
- 17. U.S. Army Environmental Hygiene Agency, Environmental Sampling Guide, May 1991.
- 18. Chemical and Biological Defense Command, Compendium of Analytical Methods for Military Chemical Agents and Associated Compounds, DRAFT, December 1997.
- 19. Meeting Minutes, Results of a Workshop Meeting to Discuss Protection of Public Health and Safety During Reentry into Areas Potentially Contaminated with a Lethal Chemical Agent (GB, VX, or Mustard Agent), DRAFT, July 1990.
- 20. U.S. Center for Health Promotion and Preventive Medicine, Directorate of Toxicology, Health Effects Research Program, Suggested Interim Estimates of the Reference Dose (RfD) and Reference Concentration (RfC) for Certain Key Breakdown Products of Chemical Agents, December 1997.
- 21. U.S. Environmental Protection Agency, Region IX, Region 9 Preliminary Remediation Goals (PRGs) 1996, August 1996.
- 22. Department of Defense, Relative Risk Site Evaluation Primer Revised Edition, Summer 1996.
- 23. U.S. Environmental Protection Agency, Quality Assurance Management Staff, EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, Interim Final, EPA QA/R-5, August 1994.
- 24. Memorandum, DASG-HS, subject: Interim Chronic Toxicological Criteria for Chemical Warfare Compounds, August 1996.
- 25. Department of the Army, Pamphlet 40-578, Health Risk Assessment Guidance for Installation Restoration Program and Formerly Used Defense Sites, February 1991.

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26. CSEPP Reentry/Restoration Plan Workbook and Sourcebook Appendices, DRAFT, June 1994

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APPENDIX B

Figures

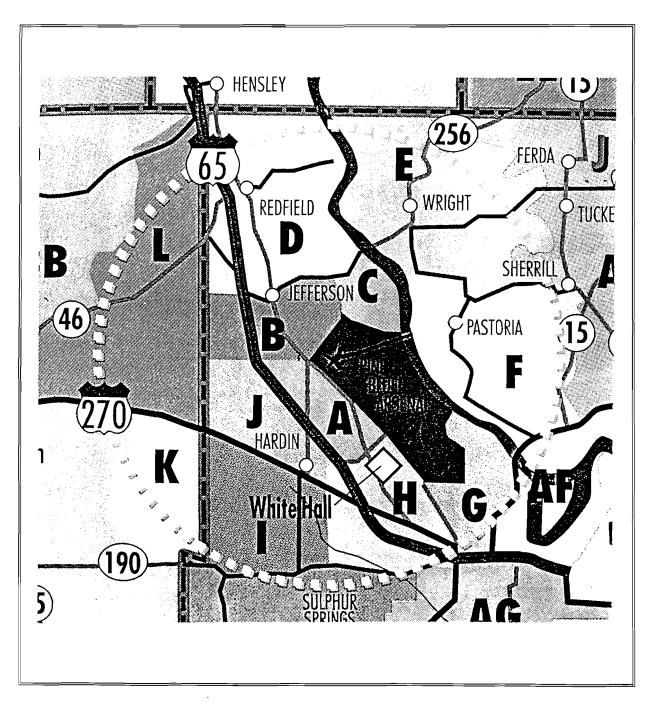
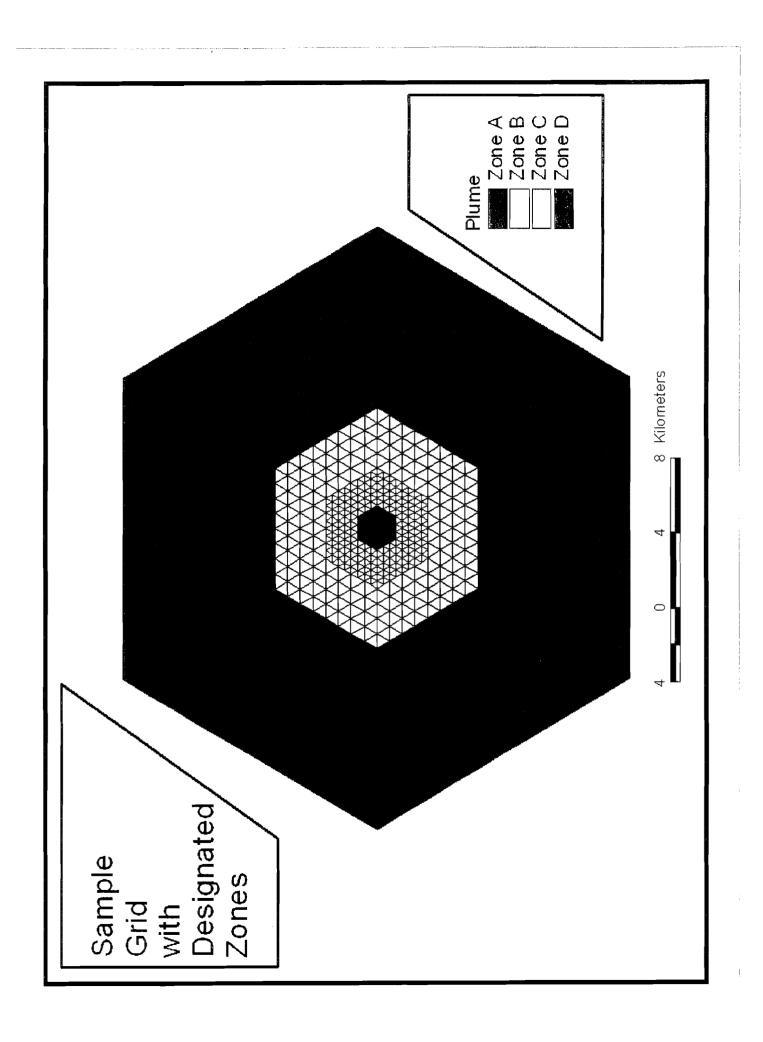


Figure 2. Immediate Response Zone.

Figure 3. Grid System.



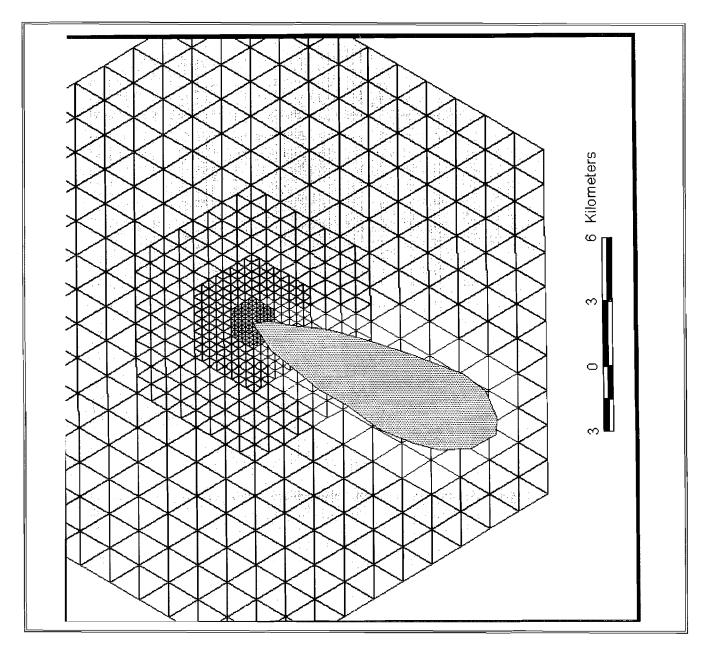


Figure 4. Initial Plume with Activated Grids

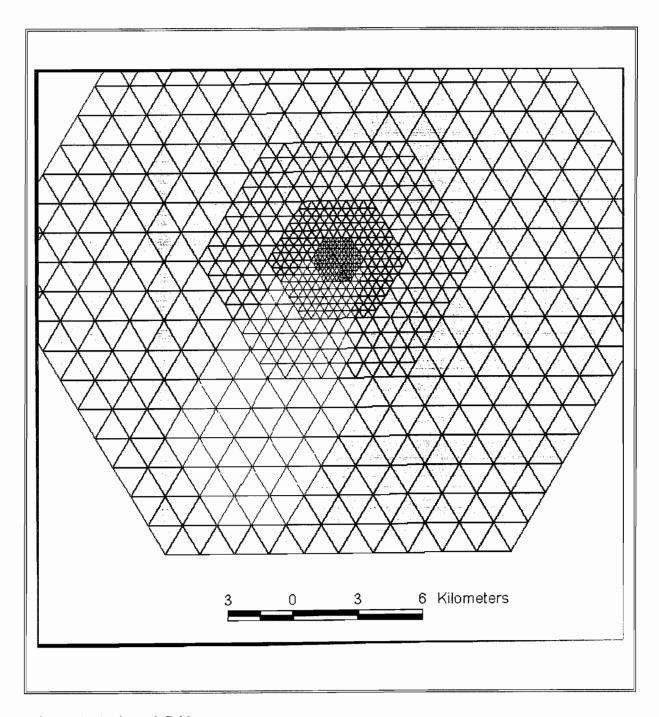


Figure 5. Activated Grids.

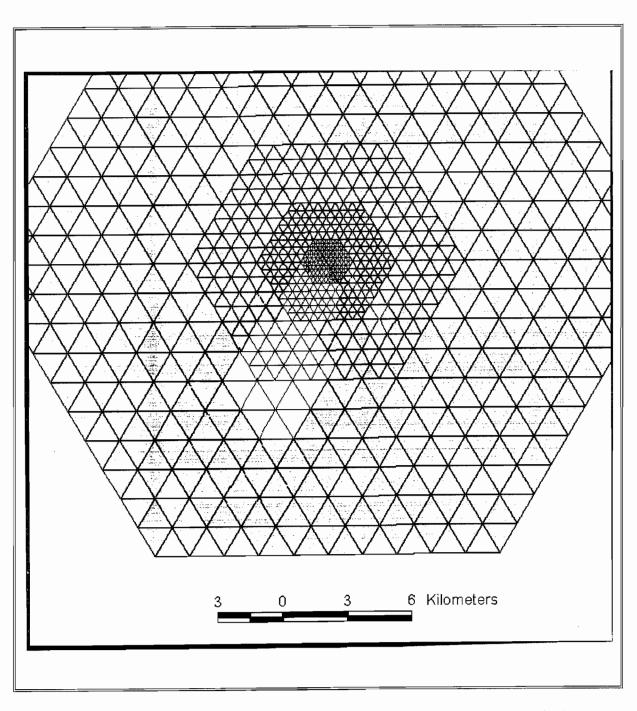


Figure 6. Collapsing of Activated Grids with Additional Activated Grids due to Field Reports.

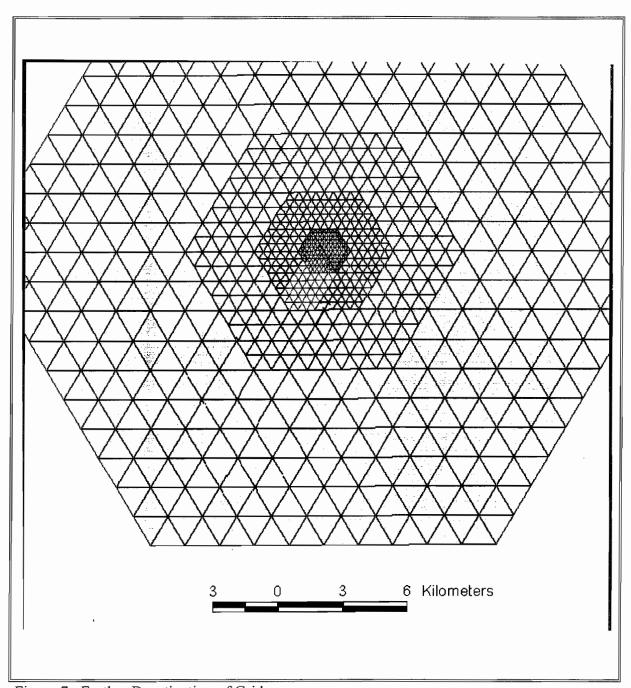


Figure 7. Further Deactivation of Grids.

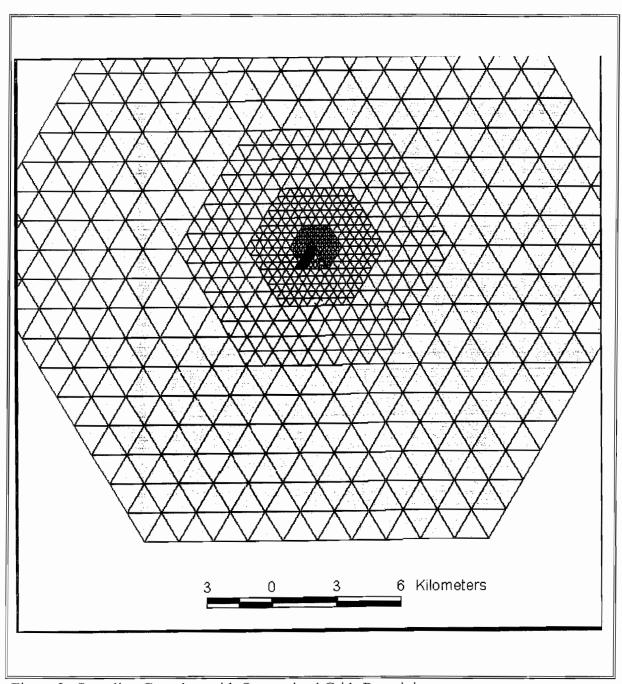


Figure 8. Sampling Complete with Quarantined Grids Remaining.

Figure 9. Grid Overlay on Scale Map.

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Pine Bluff Arsenal
Pine Bluff | Sample Grid | Sample Grid | Major Roads | Risk Zone (population) | 0 - 1834 | 1835 - 5057 | 5058 - 20488 | 20489 - 61741 | 61742 - 175795 STATE HWY 190 REDFILE Legend မ္မ

Sample Grid over Pine Bluff, AR

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